



Gaia DR2: Unravelling the Mysteries of Massive Star Formation

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What is StarFormMapper?

StarFormMapper (SFM) is a European Horizon2020 funded project which combines Gaia and Herschel data, together with ground based facilities, to constrain the mechanisms that underlie massive star and star cluster formation.

We are an international collaboration between the University of Leeds (UK), University of Cardiff (UK), University Grenoble Alpes (France) and Quasar Science Resources (Spain).

Our Aims

- Constrain the mechanisms that underpin Massive Star/Cluster formation, by
- Combining Gaia, Herschel & simulation data
- Develop new automated statistical tools and techniques to analyse the data
- Make these tools available to benefit the wider astronomical community

INDICATE

Index to **D**efine **I**nherent **C**lustering **A**nd **T**endencies

INDICATE (Buckner et al. (2018A), in review) is a novel statistical clustering tool developed by the SFM project.

What's is it?

A tool to study the intensity, correlation and spatial distribution of point processes in discrete astronomical datasets

- ◆ It is a local statistic (assigns an index, I , to every point in the dataset)
- ◆ quantifies the degree of association of each point in a 2+D discrete dataset.
- ◆ requires no a priori knowledge of – nor makes assumptions about – the sub-structure present in a dataset
- ◆ works independently of the shape of your distribution
- ◆ is applicable to any desired parameter space and type of point source object (galaxies, stars, planets etc.)
- ◆ is calibrated against random distribution so significant I values are easily identified
- ◆ the higher the index value, the higher the degree of association of a point source with other points in its local neighbourhood

Example

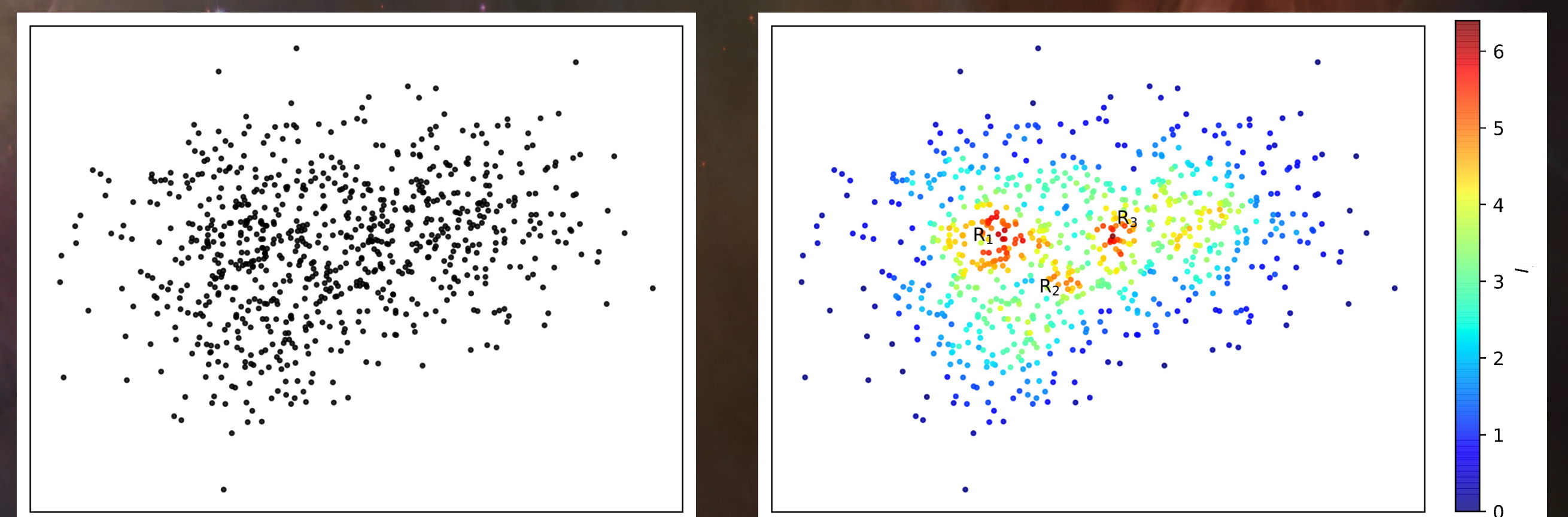


Figure 1. Plot shows a statistical dataset (left) Before and (right) After INDICATE has been applied. In the right image INDICATE has assigned an index value, I , to every point. Three concentrations of high index members have been identified (R_1 , R_2 , R_3). If this were a real astronomical dataset, where clustering behaviours are dictated by underlying physics, these index values could be used as a starting point to explore the physical causes of the identified discrepancies between the clustering behaviours. [Figure from Buckner et al. (2018A), in review]

Upper Scorpius OB Association

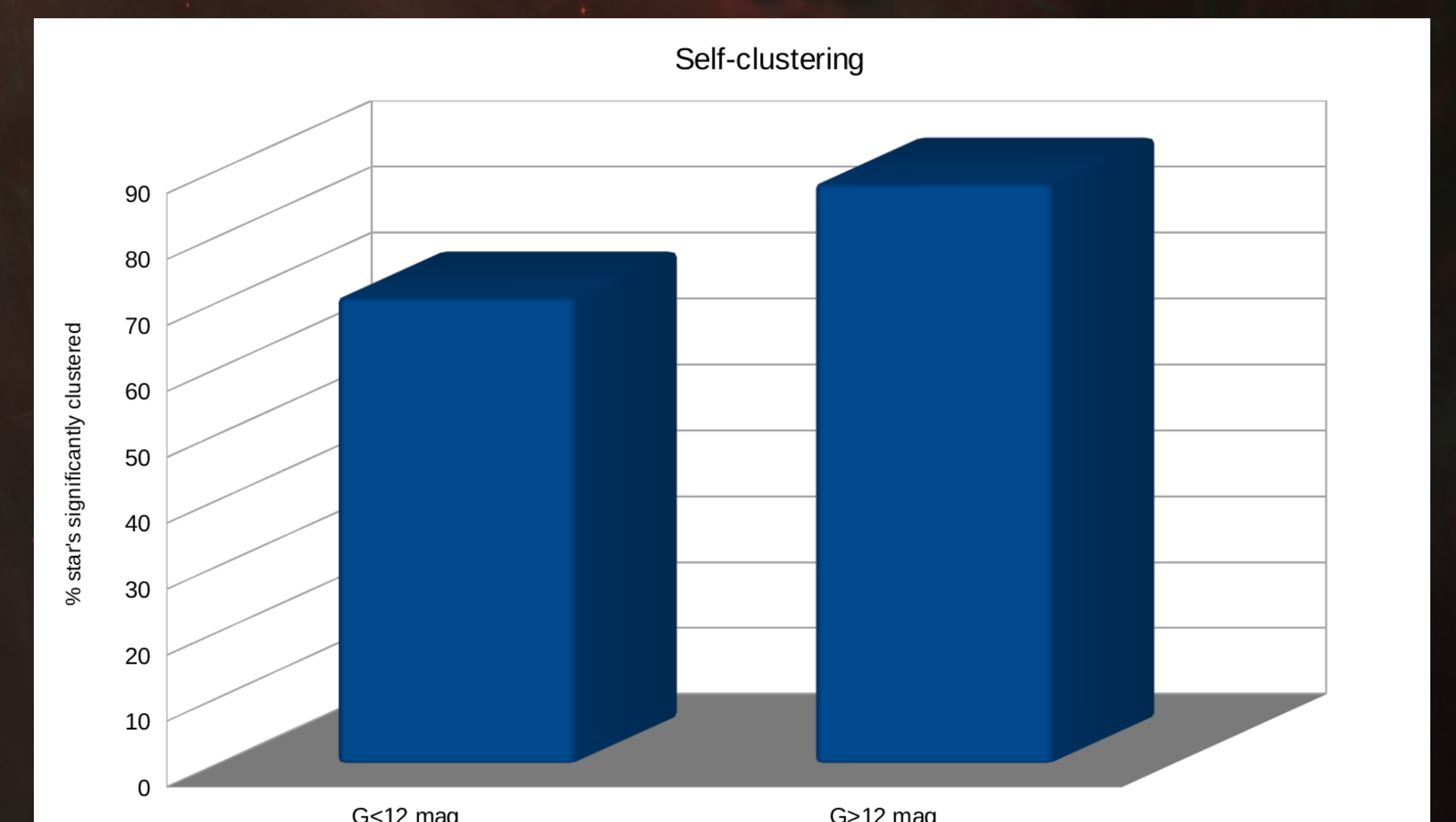
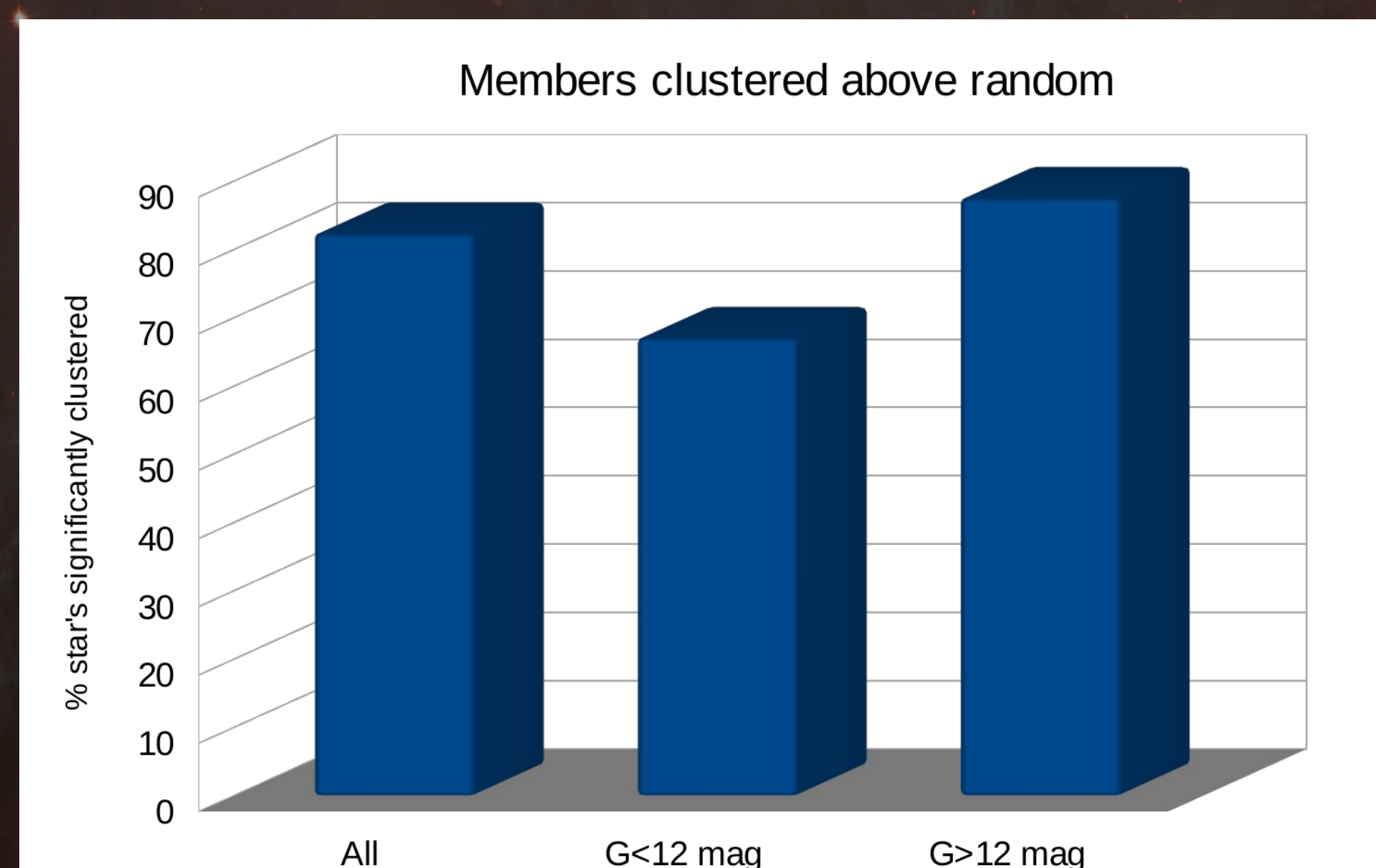
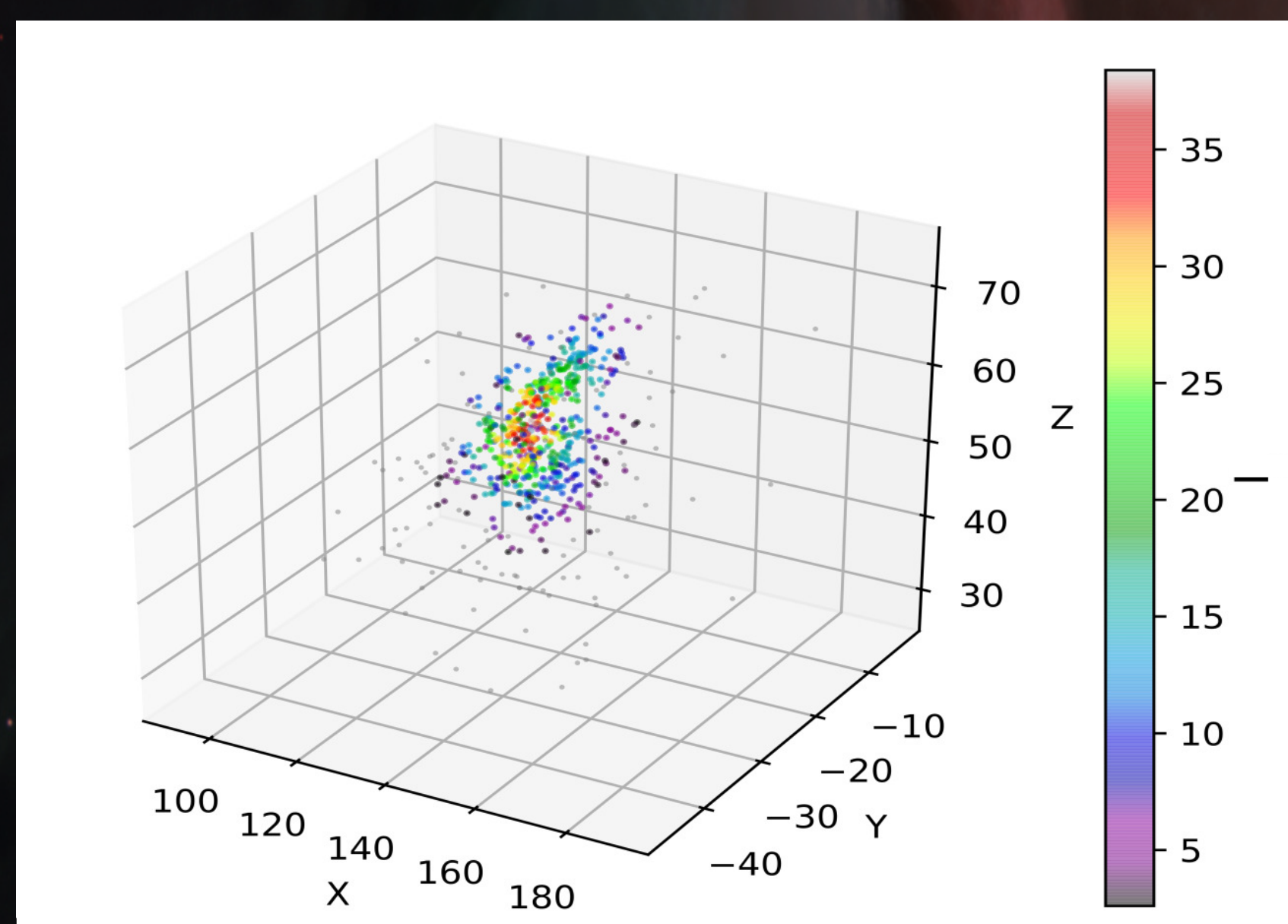


Figure 2. We applied INDICATE to members of the young Upper Scorpius OB Association, with positions and magnitudes from Gaia DR2.

(Left): Plot shows index values assigned to members. We find members have the highest degree of association at the centre of Upper Scorpius, suggesting it is centrally concentrated with little to no sub-structure.

(Middle): We compare the members index values with those expected from a random distribution in the same parameter space, and with the same number density, as Upper Scorpius. Less of the higher mass stars are in stellar concentrated regions than lower mass members.

(Right): We run indicate on subsamples of higher and lower mass members. We find that a greater proportion of lower mass stars are self-clustered than the higher mass members. From this and the middle plot, we conclude that the higher mass population are more spatially dispersed than lower mass population in the Upper Scorpius Association. We conclude this is a signature of its star formation history.

[Figure from Buckner et al. (2018B), in prep]



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Check out our publications at

<https://starformmapper.org/results/>

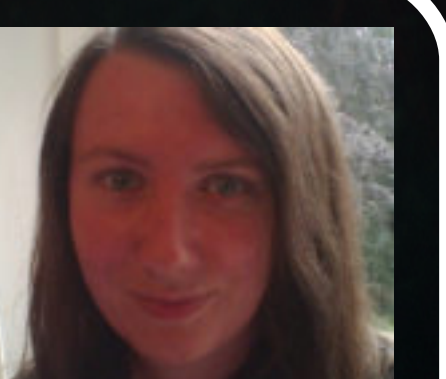


References

Buckner et al. (2018A), 'The Spatial Evolution of Young Massive Clusters I.: A New Tool to Quantitatively Trace Stellar Clustering', A&A, in review

Buckner et al. (2018B), 'The Spatial Evolution of Young Massive Clusters II.', A&A, in prep.

Background image by NASA, ESA, M. Robberto (Space Telescope Science Institute/ESA) and the Hubble Space Telescope Orion Treasury Project Team



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